Using the investment discussed above and estimated railroad industry financial inputs, we developed the capital carrying charges associated with the railroads' expected investment for each year between 2010 and 2016.[94] Using the 85 percent TIH allocation factor and the estimated capital carrying requirements, we estimated the amount of PTC investment the railroad will expect to obtain from TIH shippers.

Table 20 below summarizes the estimated costs the railroads can be expected to try to recover from TIH shippers for the installation of PTC over the first 10 years of the PTC installation process.

Table 20
Allocated PTC Capital Recovery
Charges To TIH Shippers – 2010 to 2019
(Millions)

Year (1)	Allocated PTC Capital Requirements (2)
1. 2010	$52.5
2. 2011	$116.4
3. 2012	$181.8
4. 2013	$249.8
5. 2014	$320.2
6. 2015	$393.5
7. 2016	$407.2
8. 2017	$421.3
9. 2018	$436.0
10. 2019	$451.2

Source: Attachment No. H-3

[94] The STB's DCF model requires the input of various financial statistics, including, but not limited to, cost of equity, cost of debt, industry capital structure, expected inflation rates, estimated asset lives, depreciation rates, Federal tax rates and state tax rates. In developing the DCF models for this analysis, we relied upon our estimate of the STB's annual railroad industry cost of equity and debt, average railroad industry asset lives as indicated in railroad company's annual reports to the STB, and statutory Federal and State tax rates.

As shown in Table 20 above, the capital requirements allocated to TIH shippers will grow over time. The costs shown in Table 20 above do not end in 2019, but continue into the future. For presentation purposes, we have only reflected the first 10 years of PTC capital recovery costs. The STB's DCF methodology assumes that the railroads will not just recover the costs of the initial investment in PTC, but also will recover the costs of replacement of future PTC assets. In other words, the costs shown above can be expected to continue to rise into the future.[95]

The figures contained in Table 20 above are the railroads' expected PTC investment related nominal costs that may be passed on to TIH shippers over time. Unlike the costs and benefits discussed in earlier sections of this Report that are shown on a discounted real dollar basis, the Table 20 figures are shown on a nominal dollar basis since we are estimating the annual impact on TIH shipper rates over time, which are customarily shown on a nominal dollar basis. The costs summarized above are developed using data derived from the same sources as the cost and benefit analyses discussed in earlier sections of this Report, but are not directly additive or comparable to the previous Report analyses. Rather, they reflect our estimate of the specific harm to TIH shippers from the implementation of PTC by the railroads and the railroads' expected recovery of this investment.

As indicated by the UP in *US Magnesium*, the railroads view TIH traffic as the cause of the PTC investment requirements, and will attempt to recover these costs from the TIH shippers. The railroads attempt to recover this cost, notwithstanding the PTC benefits to other shippers, will directly impact and harm TIH shippers as they will absorb much of the costs and only a small portion of the benefits.

[95] While the cost figures shown in Table 20 above may appear to be extremely large given the relatively small amount of TIH traffic transported by the railroads (less than 0.3 percent of all traffic as estimated by FRA), the railroads' cost to transport TIH before implementation of PTC are relatively high. In *US Magnesium*, the STB found the variable costs to transport chlorine traffic on 1,200 moves equaled approximately $30 per net ton and a reasonable rail rate equaled approximately $100 per net ton.

C. PTC INVESTMENTS WILL IMPACT REGULATED TIH SHIPPER RATES

Besides directly recovering their investment costs from TIH shippers by charging them higher rates, current or future TIH shippers with rates set under the STB's regulatory procedures will be impacted by the railroads' PTC investment.

The STB, like all economic regulators, must strike a balance between protecting the market from the monopoly powers of the railroads and economically strangling the companies it is regulating. A common method to strike this balance is to allow the regulated companies to charge rates such that the return on their invested capital equals the companies' cost of capital.[96] In this way, a company is earning enough to repay its investors while not extracting monopoly rents from the marketplace. One way to regulate rates based on this concept of the return on investment equaling the cost of capital is to ensure the rates charged by the company do not produce a rate of return that is greater than the companies' cost of capital.

Under this rate of return type of regulation, as a company's invested capital declines, its regulated rates or prices should decline holding all else constant. This is because as the amount invested declines, the amount of return needed to generate a sufficient return on the assets also declines. On the other hand, if a company's investment increases, its prices or rates should increase as the rate of required return will increase as the company now has a larger investment to recoup. Because the railroads' PTC investment will roll into their investment bases, they will be allowed to obtain a return on this investment in regulatory proceedings, which will force increases in regulated rates.

The most direct way the PTC impact will occur is in the calculation of the STB's Uniform Railroad Costing System ("URCS") variable costs. URCS is the STB's general purpose

[96] The cost of capital reflects the costs to obtain funds from financial markets based on the relative risk of the investment compared to the market as a whole. An organization whose investments generate a return equal to the cost of obtaining the funds can be thought of as "just breaking even" on the investment. It generated enough to repay the costs of obtaining the funds, but did not generate excessive economic profit on the investment.

costing system and is used in a number of STB regulated proceedings, including the testing and setting of maximum reasonable rail rates. Under the STB's methodologies, rate reasonableness is established as a ratio of movement's revenue to URCS variable costs ("R/VC").[97] This means regulated rates will change over time as the underlying URCS variable costs change. With PTC investment increasing the size of the railroads' investment base and thereby increasing their allowed return, the URCS variable costs, which include return on and of investment components, will also increase. In this way, rates on regulated TIH traffic will increase with the installation of PTC.

From an economic perspective, TIH shippers will be getting harmed from several directions. First, the railroads will attempt to recover their PTC investment by directly targeting TIH shippers for the costs of PTC installation. Second, the railroads will recover their PTC investment, in part, through higher regulated tariff rates, including regulated tariff rates for TIH shippers. This means that even those shippers that seek rate relief from the STB due to excessively high rail rates imposed by railroads for recovering PTC costs, will still end-up paying the costs of PTC investment. The railroads will essentially be "double-recovering" their PTC investments.

[97] Depending upon the size of the case and the amount of relief being sought, one of three different approaches may be used to develop the regulated rates. In all cases, the rate is eventually determined by a R/VC ratio. See STB Ex Parte No. 657 (Sub-No. 1). *Major Issues in Rail Rate Cases*, served October 30, 2006 and STB Ex Parte No. 646 (Sub-No. 1), *Simplified Standards For Rail Rate Cases*, served September 4, 2007.

VI. SUMMARY OF KEY LITERATURE REVIEWED

A. BRIEF SUMMARY OF SELECTED KEY DOCUMENTS (IN CHRONOLOGICAL ORDER)

1. **Federal Railroad Administration, June 1995** - ***Differential GPS: An Aide to Positive Train Control*** - - This report was completed by FRA at the request of the Senate Appropriations Committee to outline the benefits, costs, desirability, feasibility and implications of using Differential GPS to establish PTC. In this report, FRA suggested that the nation would save approximately $35 million per year in avoided collision and over-speed railroad accidents alone.[98] The FRA referred to the Association of American Railroads' estimate that nation-wide PTC would cost over $800 million before maintenance expenses for all major railroads in the United States. The FRA suggested that higher quality service, reduced fuel consumption, and more efficient use of existing systems could provide benefits to the railroads valued in the hundreds of millions of dollars annually.[99] At this time, the FRA concluded that further study was required to make more accurate estimates of costs and benefits to determine the practicality of PTC.

2. **Railroad Safety Advisory Committee, August 1999** - ***Implementation of Positive Train Control Systems*** - - In this report, RSAC attempted to quantify average costs associated with avoidable railroad accidents. This included fatalities, injuries, equipment damage, track damage, off right-of-way damage, hazardous materials cleanup, evacuations, loss of lading, wreck clearing and delays.

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[98] See *"Differential GPS: An Aide to Positive Train Control"* page 12.
[99] See *"Differential GPS: An Aide to Positive Train Control"* page 13.

The RSAC report also attempted to quantify "other" benefits that were not safety related. The report stated that reduced manpower requirements, elimination of existing wayside signals, increased capacity, increased equipment utilization, and reduced fuel consumption can all be achieved through the implementation of PTC.[100]

For this analysis, RSAC divided the quantification into four PTC levels numbered 1 to 4. The PTC level 1 was the least expensive implementation and PTC level 4 was the most expensive. The report claimed a total system cost for implementing PTC on the five largest railroads to be between $1.2 billion for level 1 and $7.8 billion for level 4. The corresponding benefits range from $485 million to $843 million including avoidable accidents. The analysis concluded that the highest benefit to cost ratio (of 0.42) would be achieved using the lowest cost, entry level PTC implementation.[101]

3. **Zeta-Tech Associates, March 15 2004** - ***Quantification of the Business Benefits of Positive Train Control*** - - Zeta-Tech was tasked by the FRA to prepare an in-depth analysis of all foreseeable business benefits of PTC. The Zeta-Tech report, like the RSAC report, contained a range of different PTC implementations ("PTC A" and "PTC B") and depicted both low-cost and high-cost scenarios.

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[100] See *"Implementation of Positive Train Control Systems"* page 92.

[101] See *"Implementation of Positive Train Control Systems"* page 95. The RSAC report developed its "Benefit to Cost" ratio by dividing benefits by costs. In such an analysis, a ratio of less than one (1) means that aggregate costs are greater than aggregate benefits. In the updated analyses presented by FRA as part of the PTC Rule Making, FRA developed "Cost to Benefit" ratios where costs are divided by benefits. In those analyses, a ratio of less than one (1) indicates aggregate benefits are greater than aggregate costs. If the RSAC ratio were calculated in manner consistent with current FRA analyses, it would report a cost to benefit ratio of approximately 2.4.

The Zeta-Tech analysis concluded that implementing PTC would result in all of the benefits listed in the RSAC and a few more, including: improved capacity utilization, efficiencies from precision dispatching, fuel savings, reduced maintenance, improved equipment utilization, real-time locomotive diagnostics, improved transit times and more reliable service.[102] Zeta-Tech did not attempt to quantify maintenance of way benefits because it believed there were insufficient data to estimate a benefit. In its evaluation of PTC B (most similar to the system required under the FRA final rule), Zeta-Tech estimated direct railroad benefits in the range of $1.3 to $2.4 billion dollars annually.[103]

The Zeta-Tech report further estimated benefits to shippers. Shipper benefits included total logistics cost savings resulting from improved transit times and reliability, and reduced inventory costs. Under the PTC B scenario, Zeta-Tech estimated that shipper benefits would range from $900 million to $1.4 billion annually.[104] Zeta-Tech's estimated costs of implementing PTC B for all class I railroads ranged from $2.3 billion to $4.4 billion dollars.[105]

4. **Federal Railroad Administration, August 2004** - ***Benefits and Costs of Positive Train Control*** - - The FRA submitted a Report to Congress in August of 2004 in response to a request of the Senate Appropriations Committee using the Zeta-Tech report as the primary basis for its cost and benefits calculations. The FRA conducted a peer review workshop in which representatives of railroads, labor organizations, suppliers, and

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[102] See *"Quantification of the Business Benefits of Positive Train Control"* page 25.

[103] Stated in 2001 dollars. See *"Quantification of the Business Benefits of Positive Train Control"* pages 109- 110. All estimates are in 2001 dollars.

[104] See *"Quantification of the Business Benefits of Positive Train Control"* pages 109-110. All estimates are in 2001 dollars.

[105] See *"Quantification of the Business Benefits of Positive Train Control"* page 111. All estimates are in 2001 dollars.

shippers were invited to comment on the Zeta-Tech report and other issues relevant to PTC implementation. In the 2004 report, FRA adjusted many of Zeta-Tech's estimates in response to comments generated through the peer review workshop. For example, FRA reduced Zeta-Tech's Line Capacity benefits (avoided maintenance and avoided investment) to 40% of the original estimate. The FRA also reduced equipment ownership cost benefits to 25% of the original to adjust for idle time spent out of service and eliminated the work-order efficiency benefit.[106] The FRA also included an additional benefit associated with reduced terminal track forces, ranging from $130 million to $391 million dollars annually for PTC B. The FRA estimated total direct benefits for PTC B to range from $1.6 to $2.8 billion dollars annually.[107]

The FRA also introduced a new benefit calculation for "modal diversion" arising from rail shippers taking advantage of better rail transit times and reliability. The benefits were calculated using FRA's then new ITIC modal diversion model and would accrue as shippers took advantage of lower total logistics costs resulting from improved service and altered their logistics networks to shift volumes from truck to rail transport. The benefits largely consisted of reductions in highway truck crashes and reduced truck emissions, among other items.[108] The report detailed the estimated monetary benefits of modal diversion in Appendix D-6. For the PTC B scenario, the indirect benefits ranged from $531 million to $1.1 billion dollars annually.[109]

FRA estimated total direct and indirect benefits for PTC B to range from $2.1 to $3.9 billion dollars annually.

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[106] See *"Benefits and Costs of Positive Train Control"* page D-2.
[107] In 2001 dollars.
[108] See *"Benefits and Costs of Positive Train Control"* page 20.
[109] In 2003 dollars.

5. **Federal Railroad Administration, July 21 2009** - ***Positive Train Control Systems; Proposed Rule*** - - In July 2009, FRA drafted the proposed rule for nation-wide PTC implementation. The document clearly defined PTC and what is required from all Class I railroads. The FRA again acknowledged that it expects benefits from railroad accident reduction and efficiency gains.[110] However, FRA took a major departure from its previous PTC cost-benefits analyses. The FRA included only direct railroad implementation costs and direct railroad safety benefits in its cost-benefit estimates.

For the first time, FRA intentionally excluded direct costs and benefits accruing to shippers and indirect costs and benefits accruing to society as a result of PTC implementation. The included 20-year cost estimate on a net present value basis was $10.0 billion assuming a 7% discount rate. Annualized costs ranged from $0.93 billion to $0.95 billion.[111] The 20-year railroad safety benefit estimate was $608 million stated on a net present value basis assuming a 7% discount rate.[112]

This unprecedented exclusion of all costs and benefits aside from direct railroad implementation costs and direct railroad safety benefits resulted in a severely skewed cost-benefit ratio of 16.5. This sharply contradicts all earlier studies that placed the cost-benefit ratio near 1.0, showing that over time the total benefits carry roughly the same weight as the total costs.

In the NPRM, FRA attempted to justify its exclusion of any benefits aside from direct railroad safety benefits (reduced rail accidents) "because of significant

[110] See *"Positive Train Control Systems; Proposed Rule"* page 36002.
[111] See *"Positive Train Control Systems; Proposed Rule"* page 36002.
[112] See *"Positive Train Control Systems; Proposed Rule"* page 36002.

uncertainties regarding whether and when individual elements will be achieved."[113] This decision renders the cost-benefit analysis invalid, as discussed in detail in other sections of our Report.

Incredibly, FRA further stated that it had not updated its 2004 report (including total costs and benefits) because of the aggressive implementation schedule and the resulting lack of time. However, the FRA did in fact conduct a detailed economic analysis (finalized on July 10, 2009) which did just that - updated the 2004 Report. In the NPRM, FRA gives only passing mention to this update, citing calculations of likely additional fuel savings resulting from PTC implementation and referring to possible modal-diversion-related highway safety and environmental benefits.[114] The FRA stated that it named these benefits simply to provide "a guide to the order of magnitude of such benefits."[115]

6. **Federal Railroad Administration, July 10 2009** - ***Positive Train Control Systems; Economic Analysis*** - - FRA produced a detailed economic analysis of total costs and benefits associated with PTC implementation concurrently with its production of the PTC NPRM. The analysis was based on an update and revision to the 2004 analysis underlying the 2004 Report to Congress. In the July 2009 economic analysis, FRA calculated costs and benefits separate from, and additive to, the direct railroad costs and benefits it presented in the NPRM RIA. However, these costs and benefits were inexplicably excluded from the RIA. In the report, FRA calculated costs in three areas:

[113] See *"Positive Train Control Systems; Proposed Rule"* page 36002.
[114] See *"Positive Train Control Systems; Proposed Rule"* page 36004.
[115] See *"Positive Train Control Systems; Proposed Rule"* page 36004.

1. Indirect societal costs associated with modal diversion from rail to truck in response to assumed rail rate increases;
2. Equipment costs associated with add-on productivity enhancement systems; and
3. Maintenance costs associated with add-on productivity enhancement systems.

Over the 20-year economic analysis period (the same period as in the NPRM RIA, FRA calculated total additional costs of $10.6 billion on a net present value basis assuming a 7% discount rate.

The FRA also calculated benefits in three areas:

1. Direct shipper benefits resulting from improved rail service levels;
2. Indirect societal benefits associated with modal diversion from truck to rail in response to estimated rail efficiency increases; and
3. Direct railroad benefits associated with productivity gains resulting from the introduction of PTC and add-on productivity systems.

Over the 20-year economic analysis period, FRA calculated total additional benefits of $16.7 billion on a net present value basis assuming a 7% discount rate.

The FRA subtracted the $10.6 billion in additional costs from the $16.7 billion in additional benefits to arrive at a statement of $6.1 billion in what it termed "net business benefits." There are several problems with the methodology used by FRA and the calculations supporting its results (which are discussed at length in other sections of this Report.) Nonetheless, FRA clearly identified significant additional cost and benefits elements and developed updated estimates for those elements but it excluded them from its NPRM.

7. **Federal Railroad Administration, January 15 2010** - ***Positive Train Control Systems; Final Rule*** - - The FRA published its final rule in January of 2010. In the final

rule, FRA reduced its estimated direct railroad safety benefits from $608 to $440 million, and reduced its estimated direct railroad implementation costs from $10.0 to $9.5 billion. These changes result in a restatement of the cost-benefit ratio from 16.47 to 21.71. The FRA made no other significant changes to its NPRM methodologies or statements.

VII. BIBLIOGRAPHY OF IMPORTANT PTC-RELATED DOCUMENTS

1. Association of American Railroads. "Positive Train Control." (9 September 2009). Available from: Association of American Railroads <http://www.aar.org/safety/positivetraincontrol/ptc.aspx>

2. Association of American Railroads. "Association of American Railroads Voices PTC Concerns." (9 September 2009)). Available from: Association of American Railroads <http://www.aar.org>

3. "C&S Engineers: In their Own Words; Focus on Positive Train Control." *Progressive Railroading* (March 2010)

4. Currie, Clint. "TRB Conference Takeaways." *Concept Capital: Washington Research Group, T&I Bulletin* (14 January 2009)

5. Federal Railroad Administration. "Differential GPS: An Aid to Positive Train Control." *Report to the Committees on Appropriations* (June 1995)

6. Federal Railroad Administration. "Implementation of Positive Train Control System." In *Report of the Railroad Safety Advisory Committee to the Federal Railroad Administrator* (August 1999)

7. Federal Railroad Administration. "PTC - Benefits and Costs of Positive Train Control." *Report in Response to Request of Appropriations Committees* (August 2004)

8. Federal Railroad Administration. "Implementation of PTC Systems as Required by the Rail Safety Improvement Act of 2008." (2008)

9. Federal Railroad Administration. "FRA Issues Final Rule on Advanced Train Braking Technology." (15 October 2008)

10. Federal Railroad Administration. "Intelligent Railroad Systems - Positive Train Control (PTC)." In *PTC Analyses* (30 October 2008). Available from: Federal Railroad Administration <http://www.fra.dot.gov>

11. Federal Railroad Administration. "Positive Train Control Overview." (10 March 2009). Available from: Federal Railroad Administration <http://www.fra.dot.gov/pages/1521.shtml>

12. Federal Railroad Administration. "Positive Train Control (PTC)." (26 March 2009). Available from: Federal Railroad Administration <http://www.fra.dot.gov>

13. Federal Railroad Administration. "Positive Train Control Systems; Proposed Rule." *Federal Register Part III 49 CFT Parts 229, 234, 235* (21 July 2009)

14. Federal Railroad Administration. "Positive Train Control Systems; Final Rule." *Department of Transportation Federal Railroad Administration 49 CFR Pars 229, 234, 235, and 236 [Docket No. FRA-2006-0132, Notice No.3]* (15 January 2010)

15. Hartong, M. "Key Management Requirements for Positive Train Control Communications Security." *Institute of Electrical and Electronics Engineers* (April 2006). Available from: IEEE <http://www.ieee.org>

16. Hawkes, Alex. "Alaska's Positive Thinking." In *Railway Technology* (27 August 2008)

17. Library of Congress. "S.3493: A Bill to Require Rail Carriers to Develop Positive Rail Control System Plans for Improving." (16 September 2008). Available from: GovTrack.us <http://www.govtrack.us>

18. National Transportation Safety Board. "Implement Positive Train Control Systems." In *Most Wanted List Transportation Safety Improvements* (2007). Available from: NTSB <http://www.ntsb.gov>

19. Office of Management and Budget. "Circular A-94: Guidelines and Discount Rates For Benefit-Cost Analysis of Federal Programs." (29 October 1992). Available from: Whitehouse Website <http://www.whitehouse.gov/omb/rewrite/circulars/a094/a094.html>

20. Oliver Wyman, Inc. "Assessment of the Commercial Benefits of Positive Train Control." (23 April 2010). Available from: AAR <http://www.aar.org/NewsAndEvents/PressReleases/2010/04/~/media/AAR/NewsFiles/2010/042710WymanPTC.ashx>

21. Paterson, Rick. "Terminator V." *UBS Railroads Weekly* (18 February 2010). Available from: UBS <http://www.ubs.com/investmentresearch>

22. "Positive Train Control (PTC): Calculating Benefits & Costs of a New Railroad Control Technology" In *Journal of Transportation Research Forum* (Summer 2005)

23. "Railroads Question PTC Timetable." *Railway Age* (2007). Available from: Railway Age <http://www.railwayage.com>

24. Railroad Safety Advisory Committee. "Implementation of Positive Train Control Systems." In *Report of the RSAC to the FRA* (August 1999)

25. Roskind, Frank D. "Positive Train Control Systems: Economic Analysis." *Department of Transportation Federal Railroad Administration 49 CFR Pars 229, 234, 235, and 236 [Docket No. FRA-2006-0132, Notice No.1]* (July 10 2009)

26. STB Docket No. 42114, *US Magnesium, L.L.C. v. Union Pacific Railroad Company*, served August 24, 2009 ("*US Magnesium*")

27. Troy, Matthew. "The ABCs of PTC: A Primer on Positive Train Control & Implications for the Rails." *Citigroup Global Markets* (22 February 2010)

28. Union Pacific Railroad, "GO21: Positive Train Control (PTC) Update." (21 September 2009)

29. Union Pacific Railroad, PTC webinar, "Train Control Systems and Vital Train Management System (VTMS)", December 17, 2008.

30. Zeta-Tech Associates. "Quantification of the Business Benefits of Positive Train Control." *Prepared for the Federal Railroad Administration* (15 March 2004)

Intermediate Restatement of PTC Cost-Benefit Analysis

(Twenty-year Costs and Benefits on a Present-Value Basis Assuming a 7% Discount Rate)

Item (1)	1/15/2010 FRA Final Rule (2)	7/10/2009 FRA NPRM Economic Analysis (3)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (Accepting FRA Calculations and Methodology) (4)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (With Corrected Calculations) (5)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (With Corrected Calc. and Alt. Methodology) (6)
Costs by Category					
1. Central Office and Development	($263,232,675)	($263,232,675)	($263,232,675)	($263,232,675)	($263,232,675)
2. Wayside Equipment	($2,414,794,033)	($2,586,453,456)	($2,414,794,033)	($2,414,794,033)	($2,414,794,033)
3. On-Board Equipment	($1,390,618,364)	($1,416,706,349)	($1,390,618,364)	($1,390,618,364)	($1,390,618,364)
4. Maintenance	($5,478,877,649)	($5,741,220,231)	($5,478,877,649)	($5,478,877,649)	($5,478,877,649)
5. **Total PTC Implementation Costs**	**($9,547,522,721)**	**($10,007,612,711)**	**($9,547,522,721)**	**($9,547,522,721)**	**($9,547,522,721)**
Benefits by Category					
6. **RAILROAD SAFETY**					
7. Fatalities	$175,541,848	N/A	$175,541,848	$175,541,848	$175,541,848
8. Injuries	$133,114,717	N/A	$133,114,717	$133,114,717	$133,114,717
9. Train Delay	$16,008,043	N/A	$16,008,043	$16,008,043	$16,008,043
10. Property Damage	$103,857,000	N/A	$103,857,000	$103,857,000	$103,857,000
11. Emergency Response	$281,353	N/A	$281,353	$281,353	$281,353
12. Equipment Cleanup	$1,637,683	N/A	$1,637,683	$1,637,683	$1,637,683
13. Road Closure	$378,926	N/A	$378,926	$378,926	$378,926
14. Environmental Cleanup	$4,233,172	N/A	$4,233,172	$4,233,172	$4,233,172
15. Evacuations	$4,652,654	N/A	$4,652,654	$4,652,654	$4,652,654
16. **Total Safety Benefit**	**$439,705,396**	**$607,711,640**	**$439,705,396**	**$439,705,396**	**$439,705,396**
17. **C/B Ratio Considering DIRECT RAILROAD COSTS but Only RAILROAD SAFETY BENEFITS ((L5 x -1) / L16)**	**21.71**	**16.47**	**21.71**	**21.71**	**21.71**
OTHER COSTS (INCLUDING INDIRECT SOCIETAL COSTS)					
18. Indirect Costs (Modal Diversion, Societal Cost) 1/	N/A	($10,403,753,086)	($9,925,450,939)	($5,429,007,040)	N/A
19. Add-On Productivity System Costs	N/A	($81,964,040)	($81,964,040)	($81,964,040)	($81,964,040)
20. Add-On Productivity Maintenance Costs	N/A	($86,759,551)	($86,759,551)	($86,759,551)	($86,759,551)
21. Add-On Indirect Costs (Modal Diversion, Societal Costs) 2/	N/A	2/	2/	($109,895,939)	N/A
OTHER BENEFITS (INCLUDING INDIRECT SOCIETAL BENEFITS)					
22. Shipper Direct Productivity Benefit	N/A	$4,336,270,929	$4,336,270,929	$4,485,005,022	$4,485,005,022
23. Indirect Benefits (Modal Diversion, Societal Benefit) 3/	N/A	$7,292,457,508	$7,292,457,508	$4,109,799,418	$4,109,799,418
24. Railroad Direct Benefits	N/A	$5,073,542,554	$5,073,542,554	$5,003,737,988	$5,003,737,988
25. Indirect Benefits (Modal Diversion, Societal Benefit) 4/	N/A	4/	4/	$1,668,109,064	N/A
26. **Total Costs (L5 + L18 + L19 + L20 + L21)**	N/A	**($20,580,089,389)**	**($19,641,697,251)**	**($15,255,149,290)**	**($9,716,246,312)**
27. **Total Benefits (L16 + L22 + L23 + L24 + L25)**	N/A	**$17,309,982,631**	**$17,141,976,387**	**$17,706,356,887**	**$14,038,247,823**
28. **C/B Ratio Considering TOTAL COSTS and BENEFITS ((L26 x -1) / L27)**	N/A	**1.19**	**1.15**	**0.86**	**0.69**
29. **Retained Railroad Costs (((L5 + L19 + L20) x 20%) 5/**	N/A	**($2,035,267,260)**	**($1,943,249,262)**	**($1,943,249,262)**	**($1,943,249,262)**
30. **Railroad Retained Benefits (L24 x 20%) 5/**	N/A	**$1,014,708,511**	**$1,014,708,511**	**$1,000,747,598**	**$1,000,747,598**
31. **C/B Ratio Considering only RAILROAD RETAINED COSTS, RAILROAD RETAINED BENEFITS, and RAILROAD SAFETY BENEFITS ((L29 x -1) / ((L30 + L16))**	N/A	**1.25**	**1.34**	**1.35**	**1.35**
32. **Railroad Cost Pass-Through to Shippers ((L5 + L19 + L20) x 80%) 5/**	N/A	**($8,141,069,042)**	**($7,772,997,050)**	**($7,772,997,050)**	**($7,772,997,050)**
33. **Railroad Benefit Pass-Through to Shippers (L24 x 80%) 5/**	N/A	**$4,058,834,043**	**$4,058,834,043**	**$4,002,990,390**	**$4,002,990,390**
34. **C/B Ratio Considering only SHIPPER COSTS and BENEFITS ((L33 x -1) / (L22 + L32))**	N/A	**0.97**	**0.93**	**0.92**	**0.92**
35. **C/B Ratio Considering only SOCIETAL COSTS and BENEFITS (((L18 + L21) x -1) / (L23 + L25))**	N/A	**1.43**	**1.36**	**0.71**	**NA**

1/ FRA assumed 80% of railroad costs are passed through to shippers: indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, increased truck emissions, etc.)

2/ FRA improperly excluded from analysis: Indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, increased truck emissions, etc.)

3/ Indirect benefits factor applied to 100% of shipper direct benefits to estimate societal benefits from modal diversion (reduced highway crashes, reduced truck emissions, etc.)

4/ FRA improperly excluded from analysis: Indirect benefits factor applied to 80% of railroad direct benefits to estimate societal benefits from modal diversion (reduced highway crashes, reduced truck emissions, etc.)

5/ FRA assumes 80% of railroad costs/benefits are passed through to shippers in the form of rate increases/reductions.

Intermediate Restatement of PTC Cost-Benefit Analysis

(Twenty-year Costs and Benefits on a Present-Value Basis Assuming a 3% Discount Rate)

Item (1)	1/15/2010 FRA Final Rule (2)	7/10/2009 FRA NPRM Economic Analysis (3)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (Accepting FRA Calculations and Methodology) (4)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (With Corrected Calculations) (5)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (With Corrected Calc. and Alt. Methodology) (6)
Costs by Category					
1. Central Office and Development	($283,025,904)	($283,025,904)	($283,025,904)	($283,025,904)	($283,025,904)
2. Wayside Equipment	($2,902,751,825)	($3,109,098,454)	($2,902,751,825)	($2,902,751,825)	($2,902,751,825)
3. On-Board Equipment	($1,613,568,678)	($1,643,839,209)	($1,613,568,678)	($1,613,568,678)	($1,613,568,678)
4. Maintenance	($8,406,267,684)	($8,812,624,131)	($8,406,267,684)	($8,406,267,684)	($8,406,267,684)
5. Total PTC Implementation Costs	($13,205,614,091)	($13,848,587,718)	($13,205,614,091)	($13,205,614,091)	($13,205,614,091)
Benefits by Category					
6. RAILROAD SAFETY					
7. Fatalities	$268,999,278	N/A	$268,999,278	$268,999,278	$268,999,278
8. Injuries	$203,984,196	N/A	$203,984,196	$203,984,196	$203,984,196
9. Train Delay	$24,530,630	N/A	$24,530,630	$24,530,630	$24,530,630
10. Property Damage	$159,149,846	N/A	$159,149,846	$159,149,846	$159,149,846
11. Emergency Response	$431,143	N/A	$431,143	$431,143	$431,143
12. Equipment Cleanup	$2,509,576	N/A	$2,509,576	$2,509,576	$2,509,576
13. Road Closure	$580,664	N/A	$580,664	$580,664	$580,664
14. Environmental Cleanup	$6,486,888	N/A	$6,486,888	$6,486,888	$6,486,888
15. Evacuations	$7,129,699	N/A	$7,129,699	$7,129,699	$7,129,699
16. Total Safety Benefit	$673,801,920	$931,253,681	$673,801,920	$673,801,920	$673,801,920
17. C/B Ratio Considering DIRECT RAILROAD COSTS but Only RAILROAD SAFETY BENEFITS ((L5 x -1) / L16)	19.60	14.87	19.60	19.60	19.60
OTHER COSTS (INCLUDING INDIRECT SOCIETAL COSTS)					
18. Indirect Costs (Modal Diversion, Societal Cost) 1/	N/A	($14,958,282,651)	($14,301,930,041)	($7,817,435,143)	N/A
19. Add-On Productivity System Costs	N/A	($115,062,980)	($115,062,980)	($115,062,980)	($115,062,980)
20. Add-On Productivity Maintenance Costs	N/A	($147,600,380)	($147,600,380)	($147,600,380)	($147,600,380)
21. Add-On Indirect Costs (Modal Diversion, Societal Costs) 2/	N/A	2/	2/	($174,670,159)	N/A
OTHER BENEFITS (INCLUDING INDIRECT SOCIETAL BENEFITS)					
22. Shipper Direct Productivity Benefit	N/A	$7,505,315,578	$7,505,315,578	$7,762,747,902 [1]	$7,762,747,902
23. Indirect Benefits (Modal Diversion, Societal Benefit) 3/	N/A	$12,794,273,455	$12,794,273,455	$7,208,890,124	$7,208,890,124
24. Railroad Direct Benefits	N/A	$8,781,401,943	$8,781,401,943	$8,660,582,625	$8,660,582,625
25. Indirect Benefits (Modal Diversion, Societal Benefit) 4/	N/A	4/	4/	$6,434,132,793	N/A
26. Total Costs (L5 + L18 + L19 + L20 + L21)	N/A	($29,109,533,729)	($27,770,207,493)	($21,460,382,753)	($13,468,277,451)
27. Total Benefits (L16 + L22 + L23 + L24 + L25)	N/A	$30,012,244,656	$29,754,792,895	$30,740,155,363	$24,306,022,570
28. C/B Ratio Considering TOTAL COSTS and BENEFITS ((L26 x -1) / L27)	N/A	0.97	0.93	0.70	0.55
29. Retained Railroad Costs ((L5 + L19 + L20) x 20%) 5/	N/A	($2,822,250,216)	($2,693,655,490)	($2,693,655,490)	($2,693,655,490)
30. Railroad Retained Benefits (L24 x 20%) 5/	N/A	$1,756,280,389	$1,756,280,389	$1,732,116,525	$1,732,116,525
31. C/B Ratio Considering only RAILROAD RETAINED COSTS, RAILROAD RETAINED BENEFITS, and RAILROAD SAFETY BENEFITS ((L29 x -1) / ((L30 + L16))	N/A	1.05	1.11	1.12	1.12
32. Railroad Cost Pass-Through to Shippers ((L5 + L19 + L20) x 80%) 5/	N/A	($11,289,000,863)	($10,774,621,961)	($10,774,621,961)	($10,774,621,961)
33. Railroad Benefit Pass-Through to Shippers (L24 x 80%) 5/	N/A	$7,025,121,554	$7,025,121,554	$6,928,466,100	$6,928,466,100
34. C/B Ratio Considering only SHIPPER COSTS and BENEFITS ((L33 x -1) / (L22 + L32))	N/A	0.78	0.74	0.73	0.73
35. C/B Ratio Considering only SOCIETAL COSTS and BENEFITS (((L18 + L21) x -1) / (L23 + L25))	N/A	1.17	1.12	0.59	NA

1/ FRA assumed 80% of railroad costs are passed through to shippers: indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, incresaed truck emissions, etc.)

2/ FRA improperly excluded from analysis: indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, incresaed truck emissions, etc.)

3/ Indirect benefits factor applied to 100% of shipper direct benefits to estimate societal benefits from modal diversion (reduced highway crashes, reduced truck emissions, etc.)

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5/ FRA assumes 80% of railroad costs/benefits are passed through to shippers in the form of rate increases/reductions.

Restatement of Indirect Benefits Factor

(Based on Corrections to FRA 7/10/2009 Economic Analysis)

	7/10/2009 FRA NPRM Economic Analysis					March 2010 Restatement				
Year	Shipper Direct Benefits 1/	Indirect Societal Benefits 2/	Indirect Benefits Factor 3/	Implicit CAGR 4/	CAGR Applied	Shipper Direct Benefits 5/	Indirect Societal Benefits 5/	Indirect Benefits Factor 6/	Implicit CAGR 4/	CAGR Applied
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2009					90.01%					49.55%
2010	1,150,000,000	615,041,931	0.94		94.00%	1,309,222,112	676,976,653	0.52		51.71%
2011					98.16%					53.96%
2012					102.51%					56.31%
2013					107.05%					58.77%
2014					111.80%					61.33%
2015					116.75%					64.00%
2016					121.92%					66.79%
2017					127.32%					69.69%
2018					132.96%					72.73%
2019					138.85%					75.90%
2020	1,150,000,000	942,118,846	1.45	1.0443	145.00%	1,309,222,112	1,036,990,214	0.79	1.0436	79.21%
2021					151.42%					82.66%
2022					158.13%					86.26%
2023					165.14%					90.02%
2024					172.45%					93.94%
2025					180.09%					98.03%
2026					188.07%					102.30%
2027					196.40%					106.76%
2028					205.10%					111.41%

1/ From 2004 FRA Report to Congress, stated in 2001 real dollars.
2/ From 2004 FRA Report to Congress, stated in 2003 real dollars.
3/ It is unclear how FRA calculated these values. FRA's stated methodolody does not produce these values.
4/ CAGR = Compound Annual Growth Rate: ((2020 value / 2010 value) ^ (1 / 10)).
5/ From 2004 FRA Report to Congress, updated to correct errors and restated in 2009 real dollars.
6/ Developed using FRA's stated methodology: Column (8) / Column (7).

Summary of Errors In and Corrections To the 2004 and 2009 FRA Economic Analysis Benefits Calculations

Item	Source/ 2004 FRA Adjustment	Real Dollar Basis Period	2004 FRA Report to Congress 1/ Low-Case Estimate	High-Case Estimate	Average	Corrected 2004 FRA Report to Congress 2/ Low-Case Low	High-Case High	Average	FRA 2009 Update 3/ Average	Corrected 2009 Update 4/ Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. Line Capacity (Avoided Investment)	40% of ZETA-TECH	2001	119,813,061	168,802,026	144,307,544	123,922,649	174,591,935	149,257,292		164,287,502
2. Line Capacity (Avoided Maintenance)	40% of ZETA-TECH	2001	203,186,898	304,782,782	253,984,840	210,156,209	315,236,831	262,696,520		289,150,060
3. Precision Dispatching Efficiencies	25% of ZETA-TECH	2001	101,999,070	260,005,293	181,002,182	105,497,638	268,923,475	187,210,556		206,062,659
4. Locomotive Maintenance Reduction	100% of ZETA-TECH	2001	28,567,603	28,567,603	28,567,603	29,547,472	29,547,472	29,547,472		32,522,902
5. Locomotive Road Failure Reduction	100% of ZETA-TECH	2001	34,603,875	34,603,875	34,603,875	35,790,788	35,790,788	35,790,788		39,394,920
6. Fuel Savings	100% of ZETA-TECH	2001	55,949,775	130,549,475	93,249,625	57,868,852	135,027,322	96,448,087	437,500,000	437,500,000
7. Terminal Track Forces Efficiencies	FRA DEVELOPED	2002	130,393,843	391,181,530	260,787,687	132,519,263	397,557,789	265,038,526		291,727,905
8. Annual Maintenance Costs	**Based on Z-T Costs 5/**	2001	**(550,756,500)**	**(306,538,500)**	(428,647,500)	-	-	-		-
9. RR Direct Benefit	Sum of Lines 1-8	2001	123,757,625	1,011,954,084	567,855,855	695,302,870	1,356,675,612	1,025,989,241		1,460,645,948
10. RR Direct Benefit Retention Rate	FRA ASSUMPTION	N/A	0.20	0.20	0.20	0.20	0.20	0.20		0.20
11. RR Retained Benefit	Line 9 x Line 10	2001	24,751,525	202,390,817	113,571,171	139,060,574	271,335,122	205,197,848		292,129,190
12. Shipper Direct Benefits	100% of ZETA-TECH	2001	900,000,000	1,400,000,000	1,150,000,000	930,870,000	1,448,020,000	1,189,445,000	1,265,805,000	1,309,222,112
13. Shipper pass-thru Benefits	**Line 9 - Line 11 6/**	2001	**649,762,600**	**1,116,101,767**	882,932,184	556,242,296	1,085,340,490	820,791,393		1,168,516,759
14. Shipper Total Benefits	Line 12 + Line 13	2001	1,549,762,600	2,516,101,767	2,032,932,184	1,487,112,296	2,533,360,490	2,010,236,393		2,477,738,870
15. Direct Safety Benefits	FRA/VOLPE	2003	40,237,868	95,653,623	67,945,746	40,237,868	95,653,623	67,945,746		74,787,882
16. Total Net Direct Benefits	Sum of Lines 11, 14, 15	Mixed	1,614,751,993	2,814,146,207	2,214,449,100	1,666,410,738	2,900,349,235	2,283,379,987	2,746,022,666	2,844,655,942
17. Estimated Indirect Societal Benes, 2010	FRA(ITIC)	2003	531,103,148	698,980,714	615,041,931	531,103,148	698,980,714	615,041,931		676,976,653
18. Total 2010 Benefits	Line 16 + Line 17	Mixed	2,145,855,141	3,513,126,921	2,829,491,031	2,197,513,886	3,599,329,949	2,898,421,918		3,521,632,595
19. Estimated Indirect Societal Benes, 2020	FRA(ITIC)	2003	815,070,747	1,069,166,945	942,118,846	815,070,747	1,069,166,945	942,118,846		1,036,990,214
20. Total 2020 Benefits	Line 16 + Line 19	Mixed	2,429,822,740	3,883,313,152	3,156,567,946	2,481,481,485	3,969,516,180	3,225,498,833		3,881,646,156
21. 2010 Indirect Benefit Ratio	Line 17 / Line 12		0.59	0.50	0.54	0.57	0.48	0.53	0.94	0.52
22. 2020 Indirect Benefit Ratio	Line 19 / Line 12		0.91	0.76	0.83	0.88	0.74	0.81	1.45	0.79

1/ Lines 1-20 values as included in FRA 2004 Report to Congress, Lines 21 and 22 added for this exhibit. All values are annual.
2/ Indexed all values to 2003 levels, corrected maintenance cost values, corrected shipper pass-through benefits calculation
3/ All values as included in FRA 2009 Economic Analysis, with varying degrees of support provided.
4/ Indexed all values to 2009 levels, corrected maintenance cost values, corrected shipper pass-through benefits calculation, incorporated FRA 2009 fuel benefit estimate.
5/ FRA flip-flopped the low- and high-case maintenance cost values in its 2004 Report to Congress. These costs should not be included in the benefits calculation at any rate. Maintenance costs are properly included in the direct railroad cost calculation, as FRA has done in its final rule RIA.
6/ FRA values in its 2004 Report to Congress do not match its stated methodologies.

GDP Inflators	
2001-2002	1.0177
2001-2003	1.0343
2001-2009	1.1385
2002-2003	1.0163
2002-2009	1.1187
2003-2009	1.1007
SOURCE: http://cost.jsc.nasa.gov/inflateGDP.html	

Restatement of PTC Cost-Benefit Analysis

(Twenty-year Costs and Benefits on a Present-Value Basis Assuming a 7% Discount Rate)

Item		1/15/2010 FRA Final Rule	7/10/2009 FRA NPRM Economic Analysis	Final Rule Costs and Safety Benefits; Restated NPRM Business Benefits (Accepting FRA Calculations and Methodology)	Final Rule Costs and Safety Benefits; Restated NPRM Business Benefits (With Corrected Calculations)	Restated Final Rule Costs and Safety Benefits; NPRM Business Benefits (With Corrected Calculations)
		(1)	(2)	(3)	(4)	(5)	(6)
	Costs by Category						
1.	Central Office and Development	($263,232,675)	($263,232,675)	($263,232,675)	($263,232,675)	($263,232,675)
2.	Wayside Equipment	($2,414,794,033)	($2,586,453,456)	($2,414,794,033)	($2,414,794,033)	($2,414,794,033)
3.	On-Board Equipment	($1,390,618,364)	($1,416,706,349)	($1,390,618,364)	($1,390,618,364)	($1,278,119,676)
4.	Maintenance	($5,478,877,649)	($5,741,220,231)	($5,478,877,649)	($5,478,877,649)	($4,437,320,607)
5.	**Total PTC Implementation Costs**	**($9,547,522,721)**	**($10,007,612,711)**	**($9,547,522,721)**	**($9,547,522,721)**	**($8,393,466,990)**
	Benefits by Category					
6.	**RAILROAD SAFETY**					
7.	Fatalities	$175,541,848	N/A	$175,541,848	$175,541,848	$175,541,848
8.	Injuries	$133,114,717	N/A	$133,114,717	$133,114,717	$133,114,717
9.	Train Delay	$16,008,043	N/A	$16,008,043	$16,008,043	$16,008,043
10.	Property Damage	$103,857,000	N/A	$103,857,000	$103,857,000	$103,857,000
11.	Emergency Response	$281,353	N/A	$281,353	$281,353	$281,353
12.	Equipment Cleanup	$1,637,683	N/A	$1,637,683	$1,637,683	$1,637,683
13.	Road Closure	$378,926	N/A	$378,926	$378,926	$378,926
14.	Environmental Cleanup	$4,233,172	N/A	$4,233,172	$4,233,172	$4,233,172
15.	Evacuations	$4,652,654	N/A	$4,652,654	$4,652,654	$4,652,654
16.	**Total Safety Benefit**	**$439,705,396**	**$607,711,640**	**$439,705,396**	**$439,705,396**	**$439,705,396**
17.	**C/B Ratio Considering DIRECT RAILROAD COSTS but Only RAILROAD SAFETY BENEFITS ((L5 x -1) / L16)**	**21.71**	**16.47**	**21.71**	**21.71**	**19.09**
	OTHER COSTS (INCLUDING INDIRECT SOCIETAL COSTS)					
18.	Indirect Costs (Modal Diversion, Societal Cost) 1/	N/A	($10,403,753,086)	($9,925,450,939)	($5,429,007,040)	($5,429,007,040)
19.	Add-On Productivity System Costs	N/A	($81,964,040)	($81,964,040)	($81,964,040)	($81,964,040)
20.	Add-On Productivity Maintenance Costs	N/A	($86,759,551)	($86,759,551)	($86,759,551)	($86,759,551)
21.	Add On Indirect Costs (Modal Diversion, Societal Costs) 2/	N/A	2/	2/	($109,895,939)	($109,895,939)
	OTHER BENEFITS (INCLUDING INDIRECT SOCIETAL BENEFITS)					
22.	Shipper Direct Productivity Benefit	N/A	$4,336,270,929	$4,336,270,929	$4,485,005,022	$4,485,005,022
23.	Indirect Benefits (Modal Diversion, Societal Benefit) 3/	N/A	$7,292,457,508	$7,292,457,508	$4,109,799,418	$4,109,799,418
24.	Railroad Direct Benefits	N/A	$5,073,542,554	$5,073,542,554	$5,003,737,988	$5,003,737,988
25.	Indirect Benefits (Modal Diversion, Societal Benefit) 4/	N/A	4/	4/	$3,668,109,064	$3,668,109,064
26.	**Total Costs (L5 + L18 + L19 + L20 + L21)**	**N/A**	**($20,580,089,389)**	**($19,641,697,251)**	**($15,255,149,290)**	**($14,101,093,560)**
27.	**Total Benefits (L16 + L22 + L23 + L24 + L25)**	**N/A**	**$17,309,982,631**	**$17,141,976,387**	**$17,706,356,887**	**$17,706,356,887**
28.	**C/B Ratio Considering TOTAL COSTS and BENEFITS ((L26 x -1) / L27)**	**N/A**	**1.19**	**1.15**	**0.86**	**0.80**
29.	**Retained Railroad Costs ((L5 + L19 + L20) x 20%) 5/**	**N/A**	**($2,035,267,260)**	**($1,943,249,262)**	**($1,943,249,262)**	**($1,712,438,116)**
30.	**Railroad Retained Benefits (L24 x 20%) 5/**	**N/A**	**$1,014,708,511**	**$1,014,708,511**	**$1,000,747,598**	**$1,000,747,598**
31.	**C/B Ratio Considering only RAILROAD RETAINED COSTS, RAILROAD RETAINED BENEFITS, and RAILROAD SAFETY BENEFITS ((L29 x -1) / ((L30 + L16))**	**N/A**	**1.25**	**1.34**	**1.35**	**1.19**
32.	**Railroad Cost Pass-Through to Shippers ((L5 + L19 + L20) x 80%) 5/**	**N/A**	**($8,141,069,042)**	**($7,772,997,050)**	**($7,772,997,050)**	**($6,849,752,465)**
33.	**Railroad Benefit Pass-Through to Shippers (L24 x 80%) 5/**	**N/A**	**$4,058,834,043**	**$4,058,834,043**	**$4,002,990,390**	**$4,002,990,390**
34.	**C/B Ratio Considering only SHIPPER COSTS and BENEFITS ((L33 x -1) / (L22 + L32))**	**N/A**	**0.97**	**0.93**	**0.92**	**0.81**
35.	**C/B Ratio Considering only SOCIETAL COSTS and BENEFITS (((L18 + L21) x -1) / (L23 + L25))**	**N/A**	**1.43**	**1.36**	**0.71**	**NA**

1/ FRA assumed 80% of railroad costs are passed through to shippers: Indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, incresaed truck emissions, etc.)

2/ FRA improperly excluded from analysis: Indirect benefits factor applied to 80% of railroad direct cost to estimate societal costs from modal diversion (increased highway crashes, increased truck emissions, etc.)

3/ Indirect benefits factor applied to 100% of shipper direct benefits to estimate societal benefits from modal diversion (reduced highway crashes, reduced truck emissions, etc.)

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5/ FRA assumes 80% of railroad costs/benefits are passed through to shippers in the form of rate increases/reductions.

Restated PTC Costs Based on Changes to FRA's Maintenance and Onboard Cost Estimates

Year	Discount Factor 1/	Development & Central Office Costs	Wayside Costs	Onboard Costs	Total Installed Costs 2/	Maintenance Costs 3/	Annual Costs 4/	Discounted Annual Costs 5/
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2009	1.00	$60,000,000	$0	$0	$60,000,000	$0	$60,000,000	$60,000,000
2010	0.93	$60,000,000	$0	$0	$120,000,000	$7,500,000	$67,500,000	$63,084,112
2011	0.87	$60,000,000	$167,654,736	$333,542,000	$681,196,736	$15,000,000	$576,196,736	$503,272,544
2012	0.82	$60,000,000	$335,309,472	$333,542,000	$1,410,048,208	$85,149,592	$814,001,064	$664,467,341
2013	0.76	$60,000,000	$502,964,208	$333,542,000	$2,306,554,417	$176,256,026	$1,072,762,234	$818,405,172
2014	0.71	$0	$1,005,928,417	$333,542,000	$3,646,024,834	$288,319,302	$1,627,789,719	$1,160,591,573
2015	0.67	$0	$1,341,237,889	$333,542,000	$5,320,804,723	$455,753,104	$2,130,532,993	$1,419,664,093
2016	0.62	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$414,191,221
2017	0.58	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$387,094,599
2018	0.54	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$361,770,653
2019	0.51	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$338,103,414
2020	0.48	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$315,984,499
2021	0.44	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$295,312,616
2022	0.41	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$275,993,099
2023	0.39	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$257,937,476
2024	0.36	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$241,063,062
2025	0.34	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$225,292,581
2026	0.32	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$210,553,814
2027	0.30	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$196,779,265
2028	0.28	$0	$0	$0	$5,320,804,723	$665,100,590	$665,100,590	$183,905,856
Total		$300,000,000	$3,353,094,723	$1,667,710,000		$9,674,285,698	$14,995,090,421	$8,393,466,990

1/ Based on a 7% discount rate.
2/ Sum of columns (3) through (5) plus column (6) from prior year.
3/ Column (6) from prior year times 12.5%.
4/ Sum of columns (3) through (5) and column (7).
5/ Column (8) times column (2).

Estimated PTC Installation Capital Costs By Year

(millions of dollars)

	Year		UP	BNSF	CSXT	NS	CN	CP	KSC	Total 1/
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
1.	2010	2/	$200	$258	$170	$40	$13	$15	$14	$710
2.	2011	3/	$240	$258	$116	$132	$37	$47	$14	$845
3.	2012	3/	$240	$258	$116	$132	$37	$47	$14	$845
4.	2013	3/	$240	$258	$116	$132	$37	$47	$14	$845
5.	2014	3/	$240	$258	$116	$132	$37	$47	$14	$845
6.	2015	3/	$240	$258	$116	$132	$37	$47	$14	$845
7.	**Total**	2/	$1,400	$1,550	$750	$700	$198	$250	$85	$4,933

1/ Sum of Columns (2) to (8).
2/ Source: Railroad investor reports, equity analysts conference calls and SEC reports.
3/ [Line 7 - Line 1] x 20%.

Estimated Percentage Of
PTC Costs To Be Recovered From TIH Shippers

Item (1)	Source (2)	Statistic (3)
Miles of Track Subject to PTC		
1. Rail Miles Subject to PTC Installation	FRA NPRM at 35964	69,000
2. Miles Carrying Both TIH and Passengers	FRA NPRM at 35964	18,000
3. Miles Carrying Only Passengers	FRA NPRM at 35964	6,000
4. Miles Of Track Subject To PTC Due To Only To Carrying TIH Commodities	L.1 - L.2 - L.3	45,000
Weighting of PTC Cost Recovery		
5. Percentage of PTC Cost Allocated To TIH Track Without Passenger Operations	1/	100%
6. Percentage of PTC Cost Allocated To TIH Track Along Amtrak Routes	1/	75%
7. Percentage of PTC Cost Allocated To TIH Track Along Commuter Rail Routes	1/	0%
Allocation of PTC Costs To TIH		
8. Weighted Route Miles Allocated To TIH	(L. 3 x L. 5) + (L.2 x L.6)	58,500
9. Estimated TIH Cost Allocation	L.8 ÷ L.1	85%

1/ Allocated based on Union Pacific Railroad Company's Opening Evidence in STB Docket No. 42114, *US Magnesium, L.L.C. v. Union Pacific Railroad Company*, August 24, 2009 (Public Version).

Estimated Annual Capital Carrying Charges Railroads Will Allocate To TIH Shippers For PTC Installation.

	Year	Annual Capital Carrying Charges Assuming Infinite Life 1/						Annual Required Capital Recovery 2/	Percentage Allocated To TIH Shippers By Railroads 3/	Estimated Annual Capital Recovery Railroads Will Allocate To TIH Shippers 4/
		2010	2011	2012	2013	2014	2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	2010	$61,784,911						$61,784,911	85%	$52,517,174.17
2	2011	$63,912,071	$73,002,410					$136,914,480	85%	$116,377,308.39
3	2012	$65,863,939	$75,231,894	$72,796,484				$213,892,317	85%	$181,808,469.10
4	2013	$68,072,145	$77,754,157	$75,237,102	$72,779,186			$293,842,590	85%	$249,766,201.91
5	2014	$70,430,228	$80,447,601	$77,843,366	$75,300,299	$72,761,198		$376,782,691	85%	$320,265,287.23
6	2015	$72,919,156	$83,290,502	$80,594,246	$77,961,304	$75,332,463	$72,790,829	$462,888,500	85%	$393,455,224.89
7	2016	$75,463,893	$86,197,143	$83,406,806	$80,681,972	$77,961,376	$75,331,029	$479,042,219	85%	$407,185,885.87
8	2017	$78,082,048	$89,187,629	$86,300,502	$83,481,123	$80,666,120	$77,944,494	$495,661,917	85%	$421,312,629.25
9	2018	$80,806,766	$92,299,827	$89,311,972	$86,394,197	$83,480,944	$80,664,321	$512,958,026	85%	$436,014,322.24
10	2019	$83,626,603	$95,520,668	$92,428,570	$89,408,965	$86,394,029	$83,479,094	$530,857,929	85%	$451,229,239.34

1/ Reflects annual capital carrying charges of investment, including replacement of assets, assuming an infinite life
2/ Sum of Columns (2) to (7)
3/ Source: Attachment No. 6
4/ Column (8) x Column (9)